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Ha et al.

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(54) **AI ANTENNA DRIVING DEVICE AND METHOD FOR CONTROLLING THE SAME**

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(52) **U.S. Cl.** **342/359**; 342/74; 343/766
(58) **Field of Search** 342/74, 75, 359; 343/766, 757

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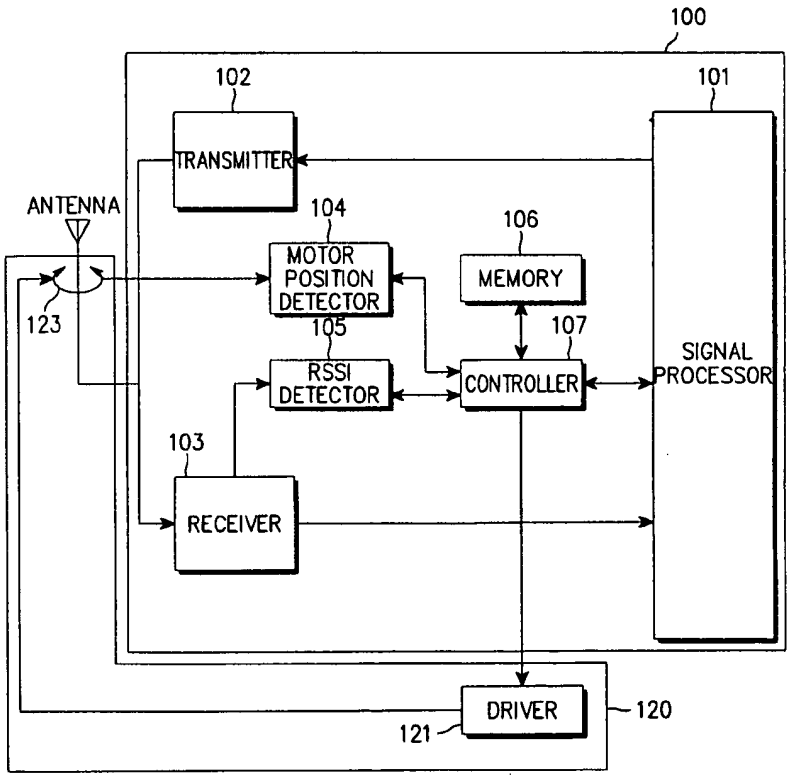
(57) **ABSTRACT**

An antenna driving device for a mobile communication terminal including a flat antenna and a receiver for receiving a radio signal through the flat antenna. The device has a flat antenna driver for shifting the direction of the flat antenna by predetermined steps; an RSSI detector for detecting the RSSI value of the received radio signal for each shifting step of the flat antenna; a position detector for detecting a position of the flat antenna through the flat antenna driver; a memory for storing the RSSI value detected for each step and the associated flat antenna positional information; and a controller for controlling the flat antenna driver and the RSSI detector, and for shifting the direction of the flat antenna to a position having the highest RSSI value by controlling the flat antenna driver. The flat antenna driver comprises a motor for shifting the direction of the flat antenna; and a driver for driving the motor under the control of the controller to shift the direction of the flat antenna.

11 Claims, 4 Drawing Sheets



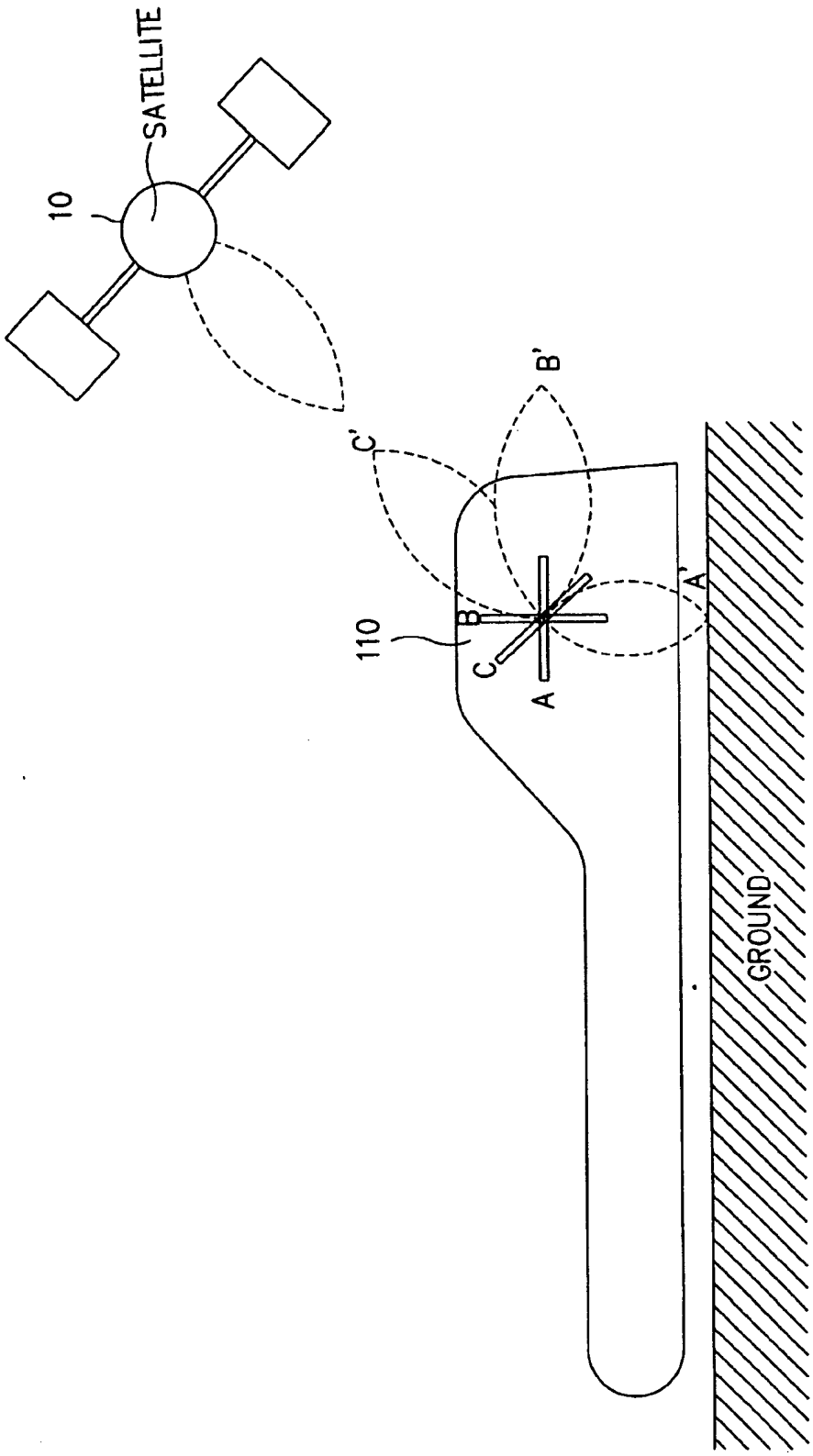


FIG. 1

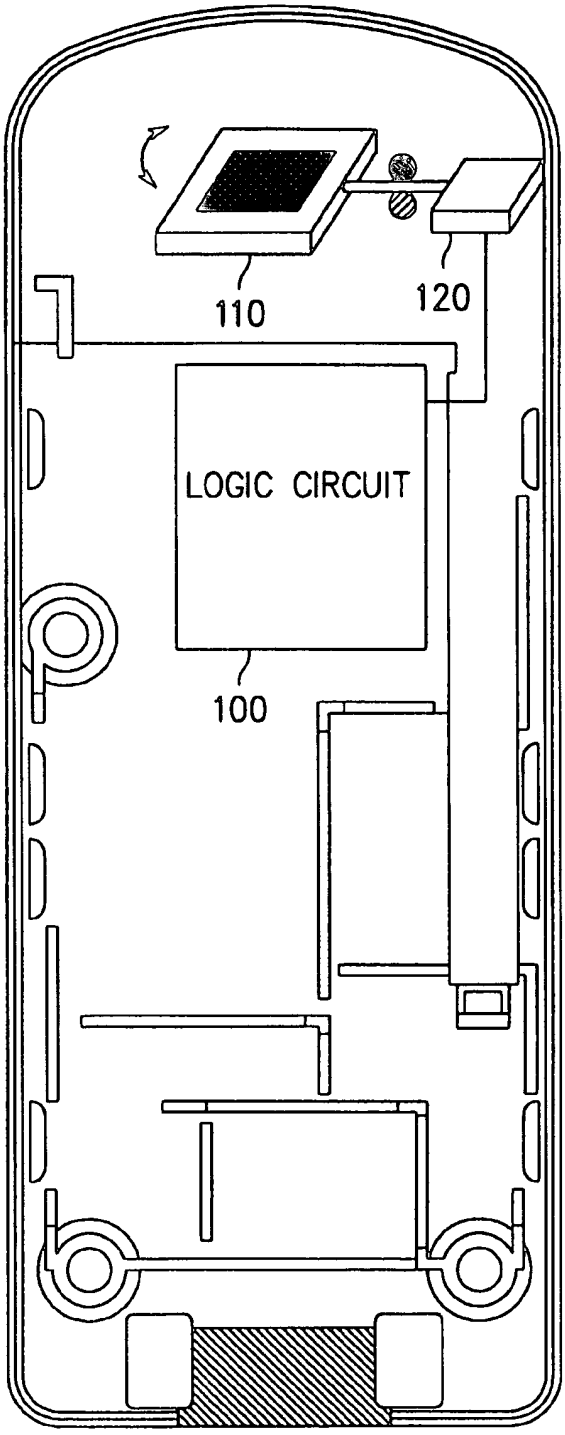


FIG. 2

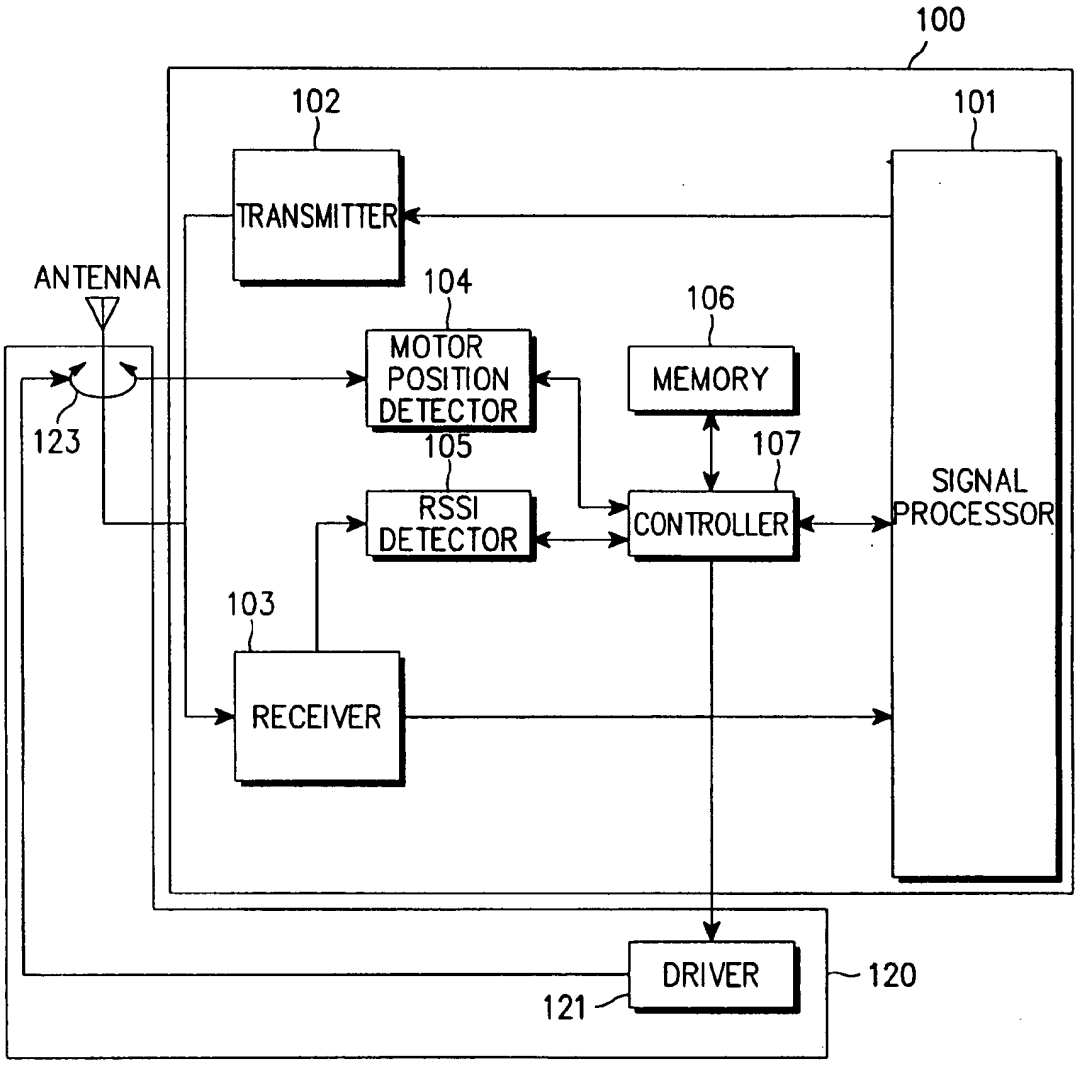

100
102
101
TRANSMITTER
ANTENNA
104
106
MOTOR POSITION DETECTOR
MEMORY
123
105
107
SIGNAL PROCESSOR
RSSI DETECTOR
CONTROLLER
103
RECEIVER
DRIVER
120
121

FIG. 3

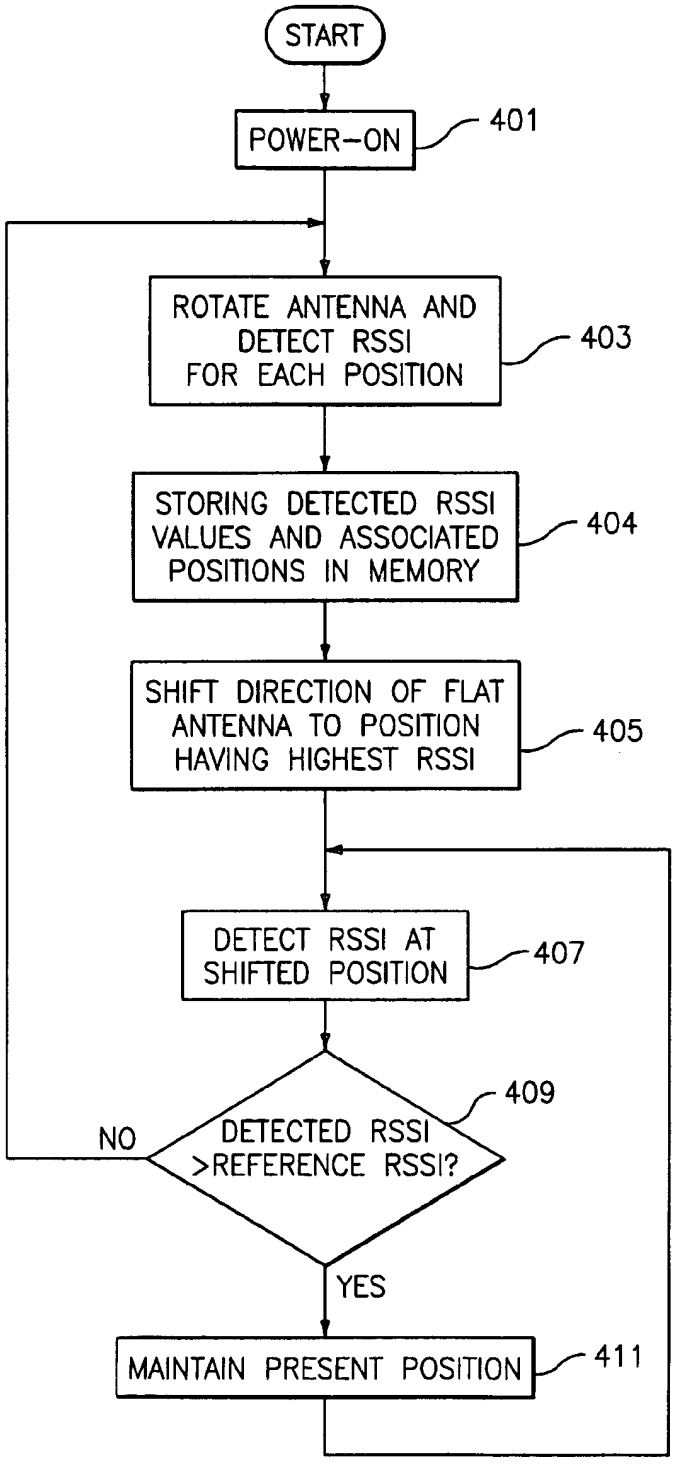

START
POWER-ON
401
ROTATE ANTENNA AND DETECT RSSI FOR EACH POSITION
403
STORING DETECTED RSSI VALUES AND ASSOCIATED POSITIONS IN MEMORY
404
SHIFT DIRECTION OF FLAT ANTENNA TO POSITION HAVING HIGHEST RSSI
405
DETECT RSSI AT SHIFTED POSITION
407
DETECTED RSSI >REFERENCE RSSI?
409
NO
YES
MAINTAIN PRESENT POSITION
411

FIG. 4

AI ANTENNA DRIVING DEVICE AND METHOD FOR CONTROLLING THE SAME

PRIORITY

This application claims priority to an application entitled "AI Antenna Driving Device and Method For Controlling the Same" filed in the Korean Industrial Property Office on Nov. 23, 1998 and assigned Ser. No. 98-50274, the contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to an antenna driving device for a mobile communication terminal, and in particular, to an AI (Artificial Intelligence) antenna driving device for automatically shifting the position (or direction) of an antenna to a position having a higher RSSI (Received Signal Strength Indicator) value, and a method for controlling the same.

2. Description of the Related Art

In general, a mobile communication terminal uses a flat antenna, such as a patch antenna, in order to increase portability of the terminal and to facilitate installation of the antenna. However, since flat antennas have a directional radiation property, their properties depend on the state of installation as well as working environment of the antenna. That is, the flat antenna points in a different direction according to whether the user carries the mobile communication terminal at the side or in a pocket, or puts the mobile communication terminal on a desk. Therefore, the flat antenna has a directivity property which depends on the circumstances of the position of the mobile communication terminal.

FIG. **1** shows the directivity property of a flat antenna, which depends on the direction of the antenna. In FIG. **1**, reference numeral **10** denotes a satellite mounted with a relay, and reference numeral **110** denotes a flat antenna. When located at a position C, the flat antenna **110** has a directivity C'. At this point, since the directivity of the flat antenna **110** is best matched to the directivity of the satellite **10**, a signal received through the flat antenna **110** has a higher RSSI. However, when located at position A, the flat antenna **110** has a directivity A'. At this point, the directivity of the flat antenna **110**, facing the ground, is not well matched to the directivity of the satellite **10**, so that the received signal of the flat antenna **110** has a lower RSSI. Further, when located at position B, the flat antenna **110** has a directivity B'. Even in this case, the directivity of the flat antenna **110** is not well matched to the directivity of the satellite **10**, thus causing a decrease in the RSSI of the flat antenna **110**.

As described above, the flat antenna has a directivity which depends on the state of installation and the working environment. The lack of proper directivity causes deterioration of the quality of communication.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide an AI antenna driving device for automatically shifting the direction of a flat antenna to a position having a higher RSSI value according to the state of installation and the working environment of the flat antenna in a mobile communication terminal, and a method for controlling the same.

In accordance with one aspect of the present invention, there is provided an antenna driving device for a mobile communication terminal including a flat antenna and a receiver for receiving a radio signal through the flat antenna. The device comprises a flat antenna driver for shifting the direction of the flat antenna by predetermined steps; an RSSI detector for detecting an RSSI value of the received radio signal for each shifting step of the flat antenna; a position detector for detecting the position of the flat antenna through the flat antenna driver, a memory for storing the RSSI value detected for each step and the associated positional information of the flat antenna; and a controller for controlling the flat antenna driver and the RSSI detector, and for shifting the direction of the flat antenna to a position having the highest RSSI value by controlling the flat antenna driver. The flat antenna driver comprises a motor for shifting the direction of the flat antenna; and a driver for driving the motor under the control of the controller to shift the direction of the flat antenna.

In accordance with another aspect of the present invention, there is provided a method for controlling an antenna driving device including a memory for storing a plurality of detected RSSI values, the flat antenna positional information associated with the detected RSSI values, and a reference RSSI value. The method comprises the steps of: upon power-on, shifting the direction of the flat antenna by predetermined steps; detecting RSSI values while the direction of the flat antenna is shifted by predetermined steps; storing the detected RSSI values and the flat antenna positional information associated with the detected RSSI values in the memory; shifting the direction of the flat antenna to the position having the highest one of the detected RSSI values; detecting an RSSI value at the shifted position and comparing the detected RSSI value with the reference RSSI value; and repeating the above procedure, if the detected RSSI value is lower than or equal to the reference RSSI value.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings in which:

FIG. **1** is a diagram illustrating the directivity property of a flat antenna, which depends on the direction of the antenna;

FIG. **2** is an interior view of a mobile communication terminal with an AI antenna driving device according to an embodiment of the present invention;

FIG. **3** is a block diagram illustrating an AI antenna driving device according to an embodiment of the present invention; and

FIG. **4** is a flow chart illustrating a method for controlling an AI antenna driving device according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will be described herein below with reference to the accompanying drawings. In the following description, well-known functions or constructions are not described in detail since they would obscure the invention in unnecessary detail.

FIG. **2** shows a plan view of a mobile communication terminal with an AI antenna driving device according to an embodiment of the present invention, and FIG. **3** shows a block diagram of an AI antenna driving device according to an embodiment of the present invention.

Referring to FIG. **2**, reference numeral **110** denotes a flat antenna, reference numeral **120** denotes a flat antenna driver, and reference numeral **100** denotes a logic circuit. The flat antenna **110**, which is a directional antenna, receives a radio signal. The flat antenna driver **120** rotates the flat antenna **110** under the control of the logic circuit **100**. The logic circuit **100** controls the overall operation of the mobile communication terminal.

Referring to FIG. **3**, the flat antenna driver **120** includes a driver **121** and a motor **123**. The driver **121** actuates the motor **123** to rotate its shaft on a step-by-step basis. The logic circuit **100** includes a signal processor **101**, a transmitter **102**, a receiver **103**, a motor position detector **104**, an RSSI detector **105**, a memory **106** and a controller **107**. The transmitter **102** converts an IF (Intermediate Frequency) signal received from the signal processor **101** to a radio signal and transmits the converted radio signal through the flat antenna **110**. The receiver **103** converts a radio signal received through the flat antenna **110** to an IF signal. The signal processor **101** converts an audio signal or data input from an external device to an IF signal and provides the converted IF signal to the transmitter **102**. Further, the signal processor **101** converts an IF signal output from the receiver **103** to an audio signal or data.

The motor position detector **104** connected to the motor **123**, is controlled to detect the position of the motor **123**. The RSSI detector **105** detects the RSSI value of the radio signal received by the receiver **103**. The memory **106** stores the detected RSSI value and its associated flat antenna positional information. In addition, the memory **106** stores a reference RSSI value. The controller **107** controls the driver **121**, the motor position detector **104** and the RSSI detector **105**. More specifically, the controller **107** controls the driver **121** to rotate the shaft of the motor **123** by predetermined steps (or angles), and detects the RSSI value for every step using the RSSI detector **105** and the motor position detector **104**. The controller **107** determines the position of the flat antenna **110** depending on the detected position of the shaft of the motor **123** and stores the RSSI value and the positional information of the flat antenna **110** in the memory **106**.

In operation, the controller **107** rotates the shaft of the motor **123** by specific angles at stated periods using the driver **121**, until the shaft is rotated by 360°. For example, if each step has an angle of 45°, 360°=45°×8. Therefore, to rotate the flat antenna **110** by 360°, the controller **107** rotates the shaft of the motor **123** by 8 steps. The controller **107** controls the motor position detector **104** to detect the position of the motor **123** whenever the shaft of the motor **123** rotates by one step, and simultaneously detects the RSSI value of the signal received by the receiver **103** using the RSSI detector **105**. The motor positional information and the RSSI value, detected for each step, are stored in the memory **106**. The controller **107** reads the positional information corresponding to the highest RSSI value of the RSSI values stored in the memory **106**, and controls the driver **121** according to the read positional information to rotate the shaft of the motor **123** to the position corresponding to the position information. Whether to correct the position (or direction) of the flat antenna **110** and the time period between position corrections can be freely determined by the user.

FIG. **4** shows a method for controlling the AI antenna driving device according to an embodiment of the present invention. Referring to FIG. **4**, upon power-on in step **401**, the controller **107** rotates the shaft of the motor **123** by predetermined steps using the driver **121** to rotate the flat antenna **110**, in step **403**. Further, the controller **107** detects the RSSI value for each step using the RSSI detector **105**, and detects the associated position of the flat antenna **110** using the motor position detector **104**. The controller **107** stores in memory **106** the RSSI value and its associated antenna positional information detected for each step in step **404**, while the flat antenna **110** makes a complete rotation of 360°. Thereafter, in step **405**, the controller **107** reads the antenna positional information corresponding to the highest RSSI value stored in memory **106** and rotates the flat antenna **110** to the corresponding position using the driver **121** and the motor **123**. After rotating the flat antenna **110** to the position having the highest RSSI value, the controller **107** periodically detects the RSSI value at this position using the RSSI detector **105** in step **407**. After each detection of the RSSI value, the controller **107** compares the detected RSSI value with a reference RSSI value stored in the memory **106** in step **409**, to determine whether the detected RSSI value is higher than the reference RSSI value. If the detected RSSI value is higher than the reference RSSI value, the controller **107** maintains the present position of the flat antenna **110** in step **411**. Otherwise, if the detected RSSI value is lower than or equal to the reference RSSI value, the controller **107** returns to step **403** to repeat the above procedure.

As described above, this novel antenna driving device automatically rotates the flat antenna to the position having the highest RSSI value according to the state of installation and working environment of the antenna, thus providing high-quality communication service.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. An antenna driving device for a mobile communication terminal including a flat antenna and a receiver for receiving a radio signal through the flat antenna, the device comprising:

a flat antenna driver for shifting a direction of the flat antenna by predetermined steps;

an RSSI (Received Signal Strength Indicator) detector for detecting an RSSI value of the received radio signal for each step of the flat antenna;

a position detector for detecting a position of the flat antenna;

a memory for storing the RSSI value detected for each step and the associated positional information of the flat antenna; and

a controller for controlling the flat antenna driver and the RSSI detector, for comparing the detected RSSI value and a reference RSSI value, and for shifting the direction of the flat antenna to a position having a highest RSSI value by controlling the flat antenna driver.

2. The antenna driving device as recited in claim **1**, wherein the flat antenna driver comprises:

a motor for shifting the direction of the flat antenna; and

a driver for driving the motor under the control of the controller to shift the direction of the flat antenna.

3. A method for controlling an antenna driving device including a memory for storing a plurality of detected RSSI values, flat antenna positional information associated with the detected RSSI values, and a reference RSSI value, the method comprising the steps of:

(a) upon power-on, shifting a direction of the flat antenna by predetermined steps;

(b) detecting RSSI values for each of the predetermined steps;

(c) storing the detected RSSI values and associated flat antenna positional information in the memory;

(d) shifting the direction of the flat antenna to a position having the highest detected RSSI value;

(e) detecting an RSSI value at the shifted position and comparing the detected RSSI value with the reference RSSI value; and

(f) repeating the steps (a) to (e), when the detected RSSI value is lower than or equal to the reference RSSI value.

4. The method as recited in claim **3**, wherein step (e) is periodically repeated while the detected RSSI value is greater than the reference RSSI value.

5. The antenna driving device as recited in claim **1**, wherein the direction of the flat antenna is shifted by a number of predetermined steps, each predetermined step being equal to degrees of rotation of a shaft of the flat antenna, said number of predetermined steps being equal to a complete rotation of the shaft of the flat antenna.

6. The antenna driving device as recited in claim **5**, wherein the antenna driver shifts the flat antenna the number of predetermined steps at predetermined periods of time.

7. The method as recited in claim **3**, wherein, in step (a), the direction of the flat antenna is shifted by a number of predetermined steps, each predetermined step being equal to degrees of rotation of a shaft of the flat antenna, said number of predetermined steps being equal to a complete rotation of the shaft of the flat antenna.

8. The method as recited in claim **7**, wherein the flat antenna is shifted the number of predetermined steps at predetermined periods of time.

9. A method for controlling an antenna driving device including a memory for storing a plurality of detected RSSI values, flat antenna positional information associated with the detected RSSI values, and a reference RSSI value, the method comprising the steps of:

shifting a direction of the flat antenna by predetermined steps;

detecting RSSI values for each of the predetermined steps;

storing the detected RSSI values and associated flat antenna positional information in memory;

shifting the direction of the flat antenna to the position having the highest detected RSSI value;

detecting an RSSI value at the shifted position:

comparing the RSSI value at the shifted position with the reference RSSI value; and

repeating periodically all of the previous steps when the detected RSSI value is lower than or equal to the reference RSSI value.

10. The method as recited in claim **9**, wherein the step of shifting the direction of the flat antenna by predetermined steps is performed upon power-on.

11. The method as recited in claim **9**, further comprising the step of:

repeating periodically the steps of claim **9** when the detected RSSI value is greater than the reference RSSI value.

* * * * *